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C-O-N-T-E-N-T-S

	Page
Sources of Potato-Blackleg Infection J. G. LEACH	59
Soil Fertility and Fertilizer Problems Facing the Potato Industry E. L. NIXON	64
Resolutions Adopted at the 16th Annual Meeting of the Potato Association of America	68
Developing Peat Beds and Getting 400 Bushel Yields of Potatoes SAM KENNEDY, JR.	69
Principles of Producing 500 Bushels of Potatoes Per Acre E. L. NIXON	71
Crop and Market News	72
Notes	75
Review of Recent Literature	79

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AMERICAN POTATO JOURNAL

PUBLISHED BY

THE POTATO ASSOCIATION OF AMERICA

EAST LANSING, MICHIGAN

Sources of Potato-Blackleg Infection

J. G. LEACH, University of Minnesota, St. Paul.

For many years it was assumed generally by plant pathologists and potato growers that potato blackleg was transmitted only through infected seed pieces and that infected seed stock constituted the sole source of infection. When a severe outbreak of blackleg occurred in a field, it was usually attributed to such infected seed stock. Until comparatively recently we have had no reliable method of checking back on the history of such seed stock to determine the justification of such conclusions. With the development of potato seed certification, however, an opportunity was afforded to do this. Careful field inspections were placed on record and when a high percentage of blackleg was found in a field grown from certified seed it was possible to check back on the records for this lot of seed and determine whether or not blackleg was present in the field in which the seed was produced. When these records are studied it is obvious that many outbreaks of blackleg occur which cannot be explained on the basis of infected seed stock.

Investigations carried out in Minnesota during the past seven years have revealed at least two additional sources of infection which in the opinion of the writer are more important in the development of potato blackleg than infection which arises from tubers produced by blackleg plants.

Blackleg bacteria can overwinter in the soil.

Another misconception which has greatly hindered progress in the solution of the blackleg problem is based on the common belief that the bacteria causing blackleg cannot survive in the

[1]Published with the approval of the Director as Paper No. 214 in the Miscellaneous Series, Minnesota Agricultural Experiment Station.

soil. This belief has been based partly on the negative results obtained by Rosenbaum and Ramsey (7) and Ramsey (6) who, in 1915 made some experiments in which they were unable to prove that the organism survived the winter in the soil. The belief has also been based to some extent on a misunderstanding of the factors influencing infection by the blackleg pathogene.

Rosenbaum and Ramsey (7) and Ramsey (6) made experiments in which they placed potato tubers, rotted by the blackleg bacteria, in the soil during October and allowed them to remain over winter. The following spring sound seed-pieces were planted in the soil among the remains of the rotted tubers. None of the plants grown from these tubers contracted blackleg. This was considered as evidence indicating that the bacteria did not survive in the soil. The justification of such a conclusion depends upon the assumption that if the bacteria were present in the soil, infection of the tubers would have resulted. Experiments by the writer (2) have shown that this assumption is not justified. Each spring during the past six years, several hundred tubers have been inoculated with the blackleg bacteria and incubated until from one-fourth to one-third of each seed piece was decayed. These tubers have been planted on various types of soils under a variety of conditions and more than 99 per cent of them have produced healthy plants. An examination of the seed pieces later in the season showed that they had formed a layer of wound cork which successfully walled off the bacteria and prevented further decay. If it is so difficult to produce the disease by such a method of inoculation we can readily see that the failure of the disease to develop in the experiments mentioned above does not necessarily indicate that the organism failed to survive.

Ramsey (6) later showed that, when broth cultures of the bacteria were poured on the soil above young potato plants, infection did not occur again showing that, although the bacteria might be present in great abundance, infection would not necessarily occur.

Rosenbaum and Ramsey (7) also attempted to reisolate the blackleg bacteria in the spring from overwintered soil which was heavily inoculated the previous fall, but were unable to do so. These authors made poured plates from samples of soil and attempted to pick out the colonies which resembled the blackleg pathogene. There are, however, so many saprophytic bacteria in the soil which produce colonies closely resembling those produced by the blackleg bacteria that it is not surprising that they were not successful in reisolating the pathogenic species.

The writer (4), using a different method of isolating the pathogene has been able to reisolate it quite readily from such

overwintered soil. The success of this method lies in the fact that the potato tuber is permitted to select the pathogen from the mixture of organisms found in such soil. A suspension of the soil is made in sterile water or sterile nutrient solution and the suspension used for inoculating potato tubers. These tubers are then placed in a moist chamber under conditions favorable for infection and unfavorable for the formation of wound cork by the tuber. Usually a small percentage of such inoculations will result in a decay which is very different from that produced by a pure culture of the blackleg bacteria. A small part of the decayed tissue nearest to the sound tissue is next removed and used for inoculating another set of tubers. Usually a more typical and more rapidly developing decay will result from this second inoculation. This process is repeated until a vigorous and rapid decay results and then plates are poured from the decayed tissue. From such plates it is relatively easy to obtain pure cultures of the pathogene. By using this method the writer has been able to demonstrate clearly that the organism can survive in the soil under the conditions obtaining in Minnesota.

Pater (5) using a crystal-violet bile agar has also succeeded in showing that the pathogene may survive the winter in the soil in Iowa.

Infection may arise from the soil.

If the organism is present in the soil there is always a possibility of infection arising from it. We have seen, however, that when seed pieces are planted under conditions favorable for growth a layer of wound cork is formed which serves as an effective barrier against the bacteria. Infection cannot occur unless some condition prevails which prevents the formation of this cork layer or enables the bacteria successfully to pass through it.

A study of factors influencing wound cork formation reveals the fact than an abundant supply of oxygen is of primary importance. Where the oxygen supply is low, wound cork cannot be produced. It has been commonly observed for many years that blackleg is usually more prevalent on heavy undrained soils than in lighter well-drained soils. Also, blackleg is usually more prevalent in wet seasons than in dry seasons. It is known that in wet soils the air spaces become filled with water which forces out the air, thus limiting the supply of oxygen. A study made by the writer has shown that wound cork formation is greatly inhibited when tubers are planted in such waterlogged soils.

What effect does this condition have on the development of the blackleg bacteria? This organism is a facultative anaerobe. In other words, it is able to grow in the absense of oxygen as well as in the presence of oxygen. Therefore, such absence

of oxygen does not inhibit its growth while the abundance of water in the soil is decidedly favorable. Thus we can see that under such conditions wound cork cannot be formed by the tubers while the bacteria may grow abundantly in this way producing conditions favorable for infection from the soil.

Blackleg may also come from infected seed-stock.

Several years ago the writer (2) showed that the seed-corn maggot was an important agent in the dissemination and inoculation of the blackleg pathogene. This insect is a common pest of the potato. The adult fly deposits eggs in the soil near potato seed pieces at or shortly after planting time. The young maggots hatch and crawl through the soil and attack the seed piece. They burrow into the tissues and effectively inoculate it with bacteria, which frequently causes it to decay and may result in the destruction of the plant by blackleg.

The eggs are frequently contaminated with the blackleg bacteria when deposited by the fly but the maggot may also pick up the pathogen from the soil or perhaps from the surface of contaminated seed pieces. The constant burrowing of the maggots into the tissues of the seed pieces effectively prevents the formation of wound cork and thoroughly inoculates the seed piece with the blackleg bacteria which then spread into the stem of the plant.

Blackleg may also come from infected seed-stock.

Thus we have two sources of infection which may result in severe outbreaks of blackleg without regard to the source of the seed stock. Nevertheless, the disease may be transmitted through infected seed pieces and this source of infection should not be disregarded. When a plant becomes affected with blackleg late in the season and is not killed until after tubers have formed it is frequently found that the decay has extended out through the stolons and has entered the seed piece through the stem end. Such tubers usually are not completely decayed but remain sound with the exception of a slight depression at the stem and a browning of the vascular bundles for some distance beyond. Experiments have shown that the bacteria may live over in tubers infected in this way and such tubers frequently give rise to blackleg plants. (33) Tubers infected in this manner appear to be less effective in corking off the bacteria than tubers inoculated through the cut surface at planting time. Experiments have shown that only a relatively small per cent (10-15 per cent) of such tubers are likely to produce blackleg plants. Therefore, when we consider the number of tubers likely to be infected in this way in a given lot of seed tubers, it appears extremely unlikely that this source of infection could result in more than a very small percentage of the infection which is frequently found in potato fields.

Conclusions

A consideration of these sources of infection naturally raises the practical question of what can be done to avoid them. The writer realizes that infection by blackleg is a complicated process and that there are a great many things which may influence the development of the disease. Furthermore, there may be still other sources of infection yet undiscovered or unproven. Control of the disease is, therefore, not a simple problem. There are, however, a number of practices which the writer believes will help to keep down losses from blackleg. The most important of these are briefly stated below:

1. Seed from fields free of blackleg should be used to avoid systematic seed infection. Where this is not possible, strict rogueing, especially late in the season, should be practiced.

2. All seed should be disinfected before planting to kill any bacteria on the seed which might cause decay when planted under unfavorable conditions. Bonde (1) has recently shown that under some conditions small lesions form on cut seed pieces and that these not only attract the maggots but also make the tubers more susceptible to maggot attack.

3. Under Minnesota conditions it is advisable to plant the seed pieces as soon as possible after cutting. It has been found that the conditions obtained in a good seed bed are excellent for the formation of wound cork over the cut surface. Seed stored for only a few days after cutting heal poorly and frequently develop slight decay which, as stated above, is conducive to maggot attack.

4. On heavy soils, undrained soils, or peat soils which are likely to be wet, potatoes should be planted rather shallow. Deep planting in such soil results in poor healing of wound and is conducive to infection from the soil.

5. Crop rotation should be practiced because there is evidence to show that under Minnesota conditions the first brood of seed-corn maggot flies emerging in the spring do not migrate very far during the first few weeks and are, therefore, to be found in greater abundance near old potato fields at planting time. There is also some evidence indicating that flies which have developed in blackleg plants are more likely to be carriers of the pathogene than those which have developed in other decaying matter.

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Soil Fertility and Fertilizer Problems Facing the Potato Industry

B. E. BROWN. Soil Fertility Investigations, Bureau of Chemistry and Soils, United States Department of Agriculture.

The area devoted to the growing of the commercial potato crop approximates 4,000,000 acres. Under average conditions, the crop is valued at something like $400,000,000 annually. From the standpoint of vegetable or truck crops, it far exceeds any other crop in value.

Owing to the high cost of producing the potato crop, because of the need for good soil, careful preparation of the seed-bed, good seed, spraying, cultivating and, probably as important as anything, plenty of fertilizer, it becomes essential for the potato grower to carefully watch every cost item.

The use of fertilizers for potatoes is recognized as one of the chief items of expense, but, nevertheless, an indispensable one. It is estimated that the 4,000,000 acres in potatoes receive 1,000,000 tons of fertilizer. This represents a large share of the total commercial fertilizer consumed in the United States. It is very likely that potato growers, taking everything into consideration, spend from forty to fifty million dollars annually for fertilizer. Certain points suggest themselves in connection with this enormous outlay for plant food every year—year in and year out. They are as follows:

(1) Considering the increasing use of fertilizers for potatoes over the past twenty-five years, it is natural to assume that more and more fertilizer will be used in potato production in the future. It is generally recognized that the use of fertilizers for potatoes is expanding greatly. This expansion is in sections where heretofore fertilizers were not considered so necessary as they now are. In such sections, there should be adequate experimental

work to guide the growers in the selection of fertilizer materials or commercial mixtures, methods of applying same, and in determining the most economical rate of application.

(2) Owing to the increasing production of synthetic nitrogen products which are being recommended for fertilizer usage, it is important that a broad study be made to determine the effect of such materials on potato growth and production on prominent soil types of the country. This is a matter of considerable importance, not only to the potato growers of the country, on account of the relatively high cost of fertilizer nitrogen, but also to the manufacturer of such products who must be guided in a large measure in his production efforts and methods by the behavior of the fertilizer ingredients toward crops. If these are beneficial or harmful to plant life, both the grower and the manufacturer are entitled to know so, and equally they should know the compartive value of these newer nitrogen fertilizer materials under actual farming conditions.

In this connection, it has been reported that, in 1929, seven American plants produced 100,000 tons of synthetic ammonia, something more than three times the output of 1928. At the present time, the daily capacity is reported to be in the neighborhood of 500 tons, while new plants are being installed in both California and Michigan. The Allied Chemical and Dye Corporation, for example, is already expanding its $125,000,000 plant,

which it began at Hopewell, Virginia, in 1928. Also, sodium nitrate, "Made in America," is fast becoming an important factor in the fertilizer market. Any skepticism as to its value in comparison with Chilean nitrate of soda is based largely on the assumption that the method of manufacturing the home product eliminates a number of the so-called impurities which are associated with the Chilean nitrate. The view is held by some that these impurities furnish sufficient other essential elements to help support plant life to better advantage than the American product. Owing generally to the greatly-increasing production of synthetic nitrogen materials, this question often arises: "What will be the effect on quality and yield of potato crops on different soil types when these relatively pure fertilizer salts, practically free from impurities, are employed more extensively? This question may become an acute one on light sandy soils if the purer salts are used continuously. This problem should be investigated and the facts ascertained.

Research is the backbone of chemical effort in synthetic nitrogen production. Millions are being spent by the leading companies. It does not require a great deal of imagination to sense how far these powerful interests will go during the next fifteen to twenty years, perhaps in less time. Such tremendous effort on the part of the industry should be adequately met by soil fertility and fertilizer investigations to determine the agricultural value of the nitrogen materials produced. In view of the importance of nitrogen in crop production, studies should be made to determines the comparative effectiveness of different sources of nitrogen fertilizer materials and how much nitrogen can be economically used in potato fertilizers.

(3) Owing to the high plant food content of many of the synthetic nitrogen materials and the recommendation that higher analysis fertilizers be used in potato production, there have been introduced to potato growers what are known as concentrated fertilizers. This term conveys its own meaning in that it represents a high concentration of plant food from two or three, and even to four times as great as ordinary-strength fertilizers. It is imperative that potato growers understand how to use such fertilizers and know their effect on the yield.

An important problem facing potato growers who may want to use concentrated fertilizers on account of saving on freight, bags, handling, storage, etc., is how to apply such material. Full evidence is lacking as to where the fertilizer should be placed with reference to the potato seedpiece and how well it should be mixed with the soil. This is a particularly important problem on light, sandy soils.

(4) Potato growers stand in pressing need, particularly in the newer fertilizer-consuming sections, of information as to how much fertilizer to apply. As the fertilizer bill represents a large

share of the cost of production, such a study is of great importance. In some potato-growing sections, it may be found that not enough fertilizer is being used to insure economical crop production.

(5) The comparative value of different potash salts for potatoes on different soil types, and the optimum amount of potash to insure economic yields and to promote quality of the tubers are important features and need further study.

(6) The influence of fertilizers, soil amendments, and soil types on the cooking qualities of potatoes is important and calls for coordinated research work to provide definite information on the matter.

(7) The relations of organic matter to the maintenance and improvement of soil fertility is one of the most urgent problems requiring study. The maintenance of a proper supply of organic matter means better utilization of applied fertilizers.

(8) The relation of lime to potato production is of great interest to potato growers, owing to its effect on excessive soil acidity and, as a result of this, on the green manure crop.

(9) A soil acidity survey in potato-growing sections where fertilizers have been used to a considerable extent is essential. The use of acid-forming fertilizers and sulphur for increasing soil acidity to prevent potato scab, and the natural effect of leaching basic material from the soil has had a tendency to increase soil acidity to such an extent that it is adversely affecting potato yields, especially in sections where the soil inclines to be naturally rather acid. A study should be made to determine what constitutes a rational use of lime and of fertilizer materials, in order to restore optimum soil reaction conditions for the potato crop. Associated with this problem is that of developing simple soil acidity tests for the use of the farmer himself.

(10) In connection with certain potato diseases, including common scab, rhizoctonia and other troubles enhanced by soil conditions, it is important that a fuller knowledge be obtained relative to the effect of fertilizers, soil amendments and disinfectants for soil treatments to prevent such soil borne diseases. In the aggregate, such troubles mean a considerable financial loss.

In conclusion, it is felt that, on account of (1) the value of the potato crop, (2) the enormous quantity of fertilizer used in its production, (3) the increasing production and use of synthetic fertilizer materials, making possible more concentrated fertilizers, and (4) the need to study the underlying soil fertility factors influencing potato production, there should be developed a broad, well-coordinated research program involving soil fertility and fertilizer problems of economic importance to the potato industry.

Resolutions Adopted at the 16th Annual Meeting of the Potato Association of America

Des Moines, Iowa, Dec. 30-31, 1929-Jan. 1, 1930.

WHEREAS, The potato growers of the United States use large quantities of fertilizer, this constituting a major item in the cost of production of the crop; and that furthermore; new fertilizer mixtures and concentrated fertilizer salts are constantly coming into the fertilizer market;

BE IT RESOLVED, That the Potato Association of America at the annual meeting at Des Moines, Iowa, do hereby heartily endorse the soil fertility studies of the Bureau of Chemistry and Soils of the United States Department of Agriculture in its cooperative effort with various Agricultural Experiment Stations to determine the nutrient requirements of potatoes on various important soil types, and the comparative value of the new nitrogen fertilizer salts as well as of concentrated fertilizer mixtures;

BE IT FURTHER RESOLVED, That the Potato Association of America in behalf of its large membership of potato growers not only advises the continuation of the studies with potatoes now being conducted by the Bureau of Chemistry and Soils, but urges that the scope of the investigation be broadened and also that the type of investigations now being conducted be extended to other important potato growing sections. It is the opinion of the association that sufficient funds should be made available for the proper continuation and the necessary expansion of this work.

E. D. ASKEGAARD, Chairman,
LOU D. SWEET,
BEN PICHA,
C. L. FITCH.

[EDITOR'S NOTE: The importance of commercial fertilizers in improving yields and quality of potatoes is well established. The need for more extensive investigational work in fertilizer materials and methods of their application is urgent. Potato growers throughout the country should be vitally interested in obtaining greater appropriations so that further fertilizer studies may be made by the United States Department of Agriculture and the Agricultural Experiment Stations.]

Developing Peat Beds and Getting 400 Bushel Yields of Potatoes

SAM KENNEDY, Jr., Clear Lake, Iowa.

Five years ago Iowa's peat lands were practically untouched so far as vegetable production was concerned. In 1929, something over 1,000 acres of vegetables, mostly potatoes, were produced on peat soils. The next few years will unquestionably see this acreage multiplied many times. Why? Because peat soils are especially well adapted to the growing of our staple vegetable crops, onions, potatoes and cabbage.

Yields are much higher and in many cases quality, size and appearance are much better than the same crops grown on loam soils in the same locality. Iowa has approximately 80,000 acres of peat and muck soils and with perhaps not over 2 per cent of this area devoted to vegetable production it can readily be seen that there is plenty of room for expansion. Let us consider briefly the location, origin and general characteristics of our Iowa peat beds.

Roughly speaking Iowa's peat land area lies in the shape of a triangle with Des Moines at the lower point and about 100

miles of the Iowa-Minnesota state line forming the base. Outside of this well defined area peat lands do not occur to any extent. What is peat or peat soil and how was it formed? Peat is simply decayed or partly decayed vegetable matter, often several feet in depth, that has formed in the bottoms of old ponds or small lakes.

There is always present a small quantity of sand or mineral soil that has washed in or been blown in while the peat was forming. These peat beds being the bottoms of ponds are generally irregular in shape and vary from a few acres to a few hundred acres in size. The surface of the beds are very level. In developing a peat bed, for vegetable production, the first thing to consider is drainage. Without adequate drainage a peat bed is a liability as losses are bound to occur at times of heavy rainfall. Much of the low land of northern Iowa has been provided a drainage outlet by county drainage projects which have been completed for some time. Large main tile lines have been laid out in a systematic manner so all that remains to complete the drainage system is to put in the laterals. Experience has shown that laterals placed 150 to 165 feet apart in peat will take care of the surplus water in good shape. Four feet is about the average depth of the lateral tile.

We like to see a peat bed 3 or 4 feet in depth, lying over a tight subsoil. This depth of peat gives a large water holding capacity and the tight subsoil keeps the soil water up high enough so that it can be easily reached by the roots of the growing crops.

The surface of a new peat bed is often very uneven and covered with hummocks and small hollows. However peat is of such a loose porous nature that a good seed bed of potatoes can generally be secured by deep plowing and plenty of discing and harrowing.

We have always made a practice of rolling our seed beds with a heavy concrete roller. This method makes a smoother, firmer surface to work on and compacts the surface so that it does not dry out so rapidly on top. Good seed is absolutely essential to high yields and best quality. A difference of 200 bushels per acre, between using northern certified seed and seed that has been grown locally for a few years, may easily occur. Stock from the northern grown seed is generally much better quality in every way.

Peat soils being very deficient in phosphorus and potash, liberal amounts of these elements must be supplied for best results. 600 to 800 pounds of 0-9-27 or 0-8-32 for potatoes and 1,000 pounds of 0-20-20 for onions is a common application and gives good results. Peat is very slow to warm up in the spring, therefore, it is probably just as well not to rush the crops in too early in the season. A comparatively heavy seeding, say 25

bushels of cut seed potatoes and 4 or 5 pounds of onion seed is advisable. With lighter seedings size is apt to be so large as to be objectionable and quality not so good. Also a heavy uniform stand is necessary for maximum yields.

Of course all the details of proper planting and careful and thorough spraying and cultivation should be carried out. This having been done and having been favored with a reasonably good growing season yields of 400 bushels of potatoes and 800 bushels of onions per acre are nothing out of the ordinary.

Under extra favorable conditions much larger yields can be secured.

Principles of Producing 500 Bushels of Potatoes Per Acre

E. L. NIXON, State College, Pa.

There are four fundamental principles involved in profitable potato production.

1. The first is ***good seed.*** There is a whole speech involved on this topic alone. Suffice it to say that the best certified is none too good.

2. The second principle is foliage protection—spraying. Herein is contained another speech. There are three factors involved in profitable potato spraying, viz.: (a) ***time of applying***—(frequently enough to keep the new growth covered and to protect against heat in dry seasons and blight in wet seasons). (b) ***manner of applying***—(high pressure over 300 lbs., proper nozzle adjustment. One must know what is aimed at). (c) ***material to apply***—(the best and the cheapest is home-made Bordeaux mixture).

3. The third principle is Humus. Herein is something basic for soil fertility. Lots of humus in the soil conserves moisture in dry years and distributes moisture in wet years. It makes heavy soil a potato soil. The best humus supply comes from legumes because they grow more of it. Soy beans, sweet clover, alfalfa, are at the top of the list.

4. The fourth principle is a proper potato mentality—vision —the opposite of tradition—science, the opposite of ignorance and superstition—ability to pick out the essential from the non-essential, the important from the unimportant. It constitutes intelligent farming.

Pennsylvania's 400 Bushel Potato Club was formulated on these principles. That it has been successful is evidenced by the fact that 868 have made the Club and another 800 have

come within 50 bushels or less of making it, with 36 over 600 bushels per acre and 141 over 500, (the high man producing 696 bushels on a measured unirrigated acre).

Some are interested in averages. I am not. It is not the average that makes the leaders in any line of endeavor.

Our 600 bushel growers—

Planted Rural Russets.
They planted 9.2 in. in the row by 29.4 in. between the rows.
They plowed down legumes.
None used corn stubble.
80 per cent used manure, 10 loads per acre.
20 per cent used soy beans.
100 per cent used the weeder an average of 5.8 times and cultivated three times.
100 per cent sprayed and averaged 13.7 times at an average pressure of 367 lbs.
All used commercial fertilizer averaging 900 pounds per acre—average analysis 4.2-10.9-5.7.

Crop and Market News

Market Prices Decline Further

(Contribution from Bureau of Agriculture Economics)

Outstanding developments during late February and early March were the further declines in prices of old and new potatoes, the gradually increasing movement of southern stock, and the March freeze which will delay shipments from northern Florida.

The lack of interest in potatoes has been surprising, in view of the relatively light holdings. Shipments have been averaging 4,700 cars a week, compared with 5,060 cars each week during the same period last year, but markets seem to be well supplied and trading has been quiet. Declines ranging from 10c to 35c per 100 pounds occurred in all shipping districts for old stock in the Pacific Northwest. The f. o. b. price in Yakima Valley of Washington advanced $8 per ton during the month. New potatoes also were considerably lower than in mid-February, even though the supply is still light.

With spring at hand, there did not seem to be much chance of any great advance in the market. The freeze will delay potatoes from the Hastings section of Florida, but movement from Federal Point was expected to begin by March 20, and then the supply will rapidly increase and competition with old potatoes will become more severe. Best Florida Spaulding Rose were still bringing $9.50-$11 per barrel in terminal markets, and bushel packages of Bliss Triumphs ranged $2.50-$3.50. Early plantings were greatly increased in the State of

Florida and in southern Texas. Nine other southern states together expect an 8% increase over their combined 1929 acreage, but that is still 8% below the five-year average.

Greatest market strength recently has been shown for Washington and Idaho stock. Shippers of Russet Burbanks in the Yakima Valley were able to get \$50-\$52.50 per ton by the middle of March, and Idaho also was in a firm position. General f. o. b. range in western producing areas was \$2.05-\$2.35 per 100 pounds. The North Central States reported most sales at \$2.05-\$2.20, compared with Green Mountains in northern Maine at low level of \$1.75-\$1.85 and Round Whites in western New York at \$2.15-\$2.25. The Chicago carlot market on northern Round Whites had declined to \$2.20-\$2.45, but Idaho Russets advanced in that city to a range of \$3.15-\$3.40. Most jobbing sales of eastern potatoes were within the limits of \$2.35 and \$3.35 per 100 pounds. But prices everywhere were still two or three times those of last spring.

Notes

CONNECTICUT

For the Largest Yields and Greatest Profit, Use Certified Seed

Mr. Potato Grower, purchase only certified seed potatoes. Because such seed offers you greater opportunity to make money. It outyields non-certified or home grown seed from 50 to 100 bushels per acre. This increase alone may mean the difference between profit and loss. Can you sacrifice greater yields and more profit by the false economy of buying cheap seed? Get the best—it pays.

In proof that certified seed outyields non-certified seed the following examples are given:

James Graham of Lisbon compared certified seed versus non-certified seed—results—certified seed yielded 362 bushels per acre; non-certified 131 bushels per acre; gain due to certified seed, 231 bushels.

John McKinstry of Ellington compared certified seed versus non-certified seed and received the following results—certified seed yielded 236.5 bushels per acre; non-certified seed 163.8 bushels per acre; gain due to certified seed, 68.7 bushels.

J. W. Moss, Cheshire compared certified seed versus non-certified seed—results—certified seed yielded 267 bushels per acre; non-certified seed 131 bushels per acre; gain due to certified seed, 136 bushels.

H. E. Baldwin, Westport compared certified seed versus non-certified seed—results—certified seed yielded 186.3 bushels per acre; non-certified 139.8 bushels per acre; gain due to certified seed 48.5 bushels.

C. B. Jennings of Green Farms, compared home saved seed which yielded 98.1 bushels per acre against freshly purchased certified seed which yielded 182.4 bushels per acre. He got an increase due to freshly purchased certified seed of 84.3 bushels per acre.

L. L. Grant of Buckland had similar results. Home saved seed yielded 255.9 bushels per acre. Freshly purchased certified seed yielded 370.8 bushels per acre. The difference due to freshly purchased certified seed was 114.9 bushels per acre.

Your Experiment Station at Storrs during a five-year period received an average gain of 63 bushels per acre from certified seed as compared to non-certified seed.

YEAR	Average Bushels Per Acre		
	Certified	Uncertified	Difference
1920	207	145	62
1921	314	258	56
1922	315	243	72
1923	252	177	75
1924	173	122	51
Average	252	189	63

All of our leading potato growers and other successful growers in nearby states are using certified seed. Compare their high yields with your own yield.

—ALBERT E. WILKINSON.

Correction

A rather unfortunate error was made in the printing of an article by Dr. E. V. Hardenburg on "Per Capita Consumption of Potatoes and Some Related Factors" published in the December number of the Journal. Apparently, one whole line was omitted, as a result of which the meaning of the first sentence in paragraph one on page 358, is reversed.

The following words should be inserted after the word "eaten" in line 2: "on the 144 farms where production is a major enterprise than were eaten."

Review of Recent Literature

Influence of Fertilization on the Health of the Potato.

J. J. Janssen (Wagennigen, Holland).

(This is a brief statement from the more complete report of the work at Wagennigen.)

Field Studies. Mosaic plants were planted at regular intervals among "absolutely" healthy plants in plats given various combinations from the three fertilizer elements, N, P & K. Four varieties were planted. The tests were duplicated—one set on heavy clay low in potassium, the other on sandy soil low in nitrogen and potassium, but rich in phosphorus. On the sandy land nitrogen shortage symptoms were most evident whereas on the clay land the shortage of potassium was most evident. The plants from the low phosphorus plats were damaged most by Phytopthera infestans, and those from the low nitrogen and potassium plats were more subject to rhizoctonia. Potatoes harvested every two weeks from July 4 to Sept. 15 when planted comparatively next year showed the lowest mosaic content in the seed stocks from the nitrogen deficient plats and the highest percentage where potassium was lacking. The soil type was not associated with any consistent effect on mosaic spread. The varieties differed very much in their susceptibility to mosaic infection. When leaf-roll plants were used in other plats the potassium deficient plants showed even more susceptibility than in the case of mosaic.

Greenhouse Studies. Potato plants grown in sand with the six different fertilizer combinations used in the field tests were protected against plant lice, etc., by gauze cages. When leaf roll or mosaic infected plant lice were localized in the tips of the plants, the leaf roll virus penetrated to the tubers in 8 out of 10 cases after 10 days in plants heavily fertilized. In the nitrogen deficient plants more time was required or the tubers never did become infected, in spite of the fact that these plants were only about one-third the size of those heavily fertilized.

When 10 plant lice were placed on plants of the different fertilizer treatments their number increased in 19 or 20 days to 25 on the plants receiving no nitrogen, which was quite in contrast to the 1,100 per plant when potassium had been omitted. With the heaviest application of fertilizer material the aphids numbered 140 on the no nitrogen and 1,800 on the no potash plants. The plant lice also developed most rapidly on the varieties which had been found to be most susceptible to virus disease (Eigenheimer and Red Star) and least rapidly on the least susceptible varieties (Thorbecke and Kruger). Plant lice also developed more rapidly on leaf roll or mosaic than on normal cuticle and produced secondary tissue (woody parenchyma)

plants. Plants lacking in nitrogen were found to have a heavier cuticle and produced secondary tissue (woody parenchyma) earlier than when nitrogen was abundant.

Potash and nitrogen deficient plants had a high sugar content which would have been desirable to aphids, but the thick cuticle of the nitrogen shortage plants was an obstacle to their existence, which obstacle did not exist with the low potash plants. The variety Kruger was found to contain less sugar than the Red Star variety. —H. O. WERNER.

Smith, Kenneth M. Studies on potato virus diseases. Insect transmission of potato leaf-roll. Ann. Appl. Biol. 16 (2); 209-229, 1929.

Inoculation experiments with seven different species of insects carried out in 1927 gave negative results, except in the case of aphis ***Myzus persicae*** Sulz. which gave a high percentage of positive infections.

Further inoculation tests with this aphis in 1928 proved it to be an efficient carrier of the leaf-roll virus.

Experiments carried out during two years on the question of the inheritance of the leaf-roll virus by the progeny of infective aphides proved negative. It is therefore assumed that the virus is not hereditary in the offspring of the aphis.

One or two virus-bearing aphides are capable of infecting a healthy potato plant with leaf-roll. Such infection when achieved differed in no degree of severity from that induced by 18 aphides. The incidence of infection was greatest among plants colonised with groups of 18 infective aphides.

Colonisation of virus-bearing aphides upon on-colonaceous hosts such as cabbage for periods varying from 24 hours to 7 days did not affect the subsequent infective power of such aphides.

M. persicae, when colonised upon plants affected with combinations of viruses of which leaf-roll was one constitutent, transmitted only leaf-roll to healthy potatoes. The combinations used were leaf-roll and streak, and leaf-roll and mosaic. In the latter case the aphis was shown by its infection of tobacco with a mottling disease, to be picking up both viruses of which only leaf-roll developed in the potato.

The incubation period of the leaf-roll virus in the plant averaged about 30 days under glasshouse conditions. In some cases the disease was found to develop in 18-20 days.

Some varieties of potato have been infected with leaf-roll by means of ***M. persicae.*** There existed no apparent difference in degree of resistance to leaf-roll.

The leaf-roll virus can be disseminated by the feeding of ***M. persicae*** either on the sprouts of the tuber, on the leaves and shoots of the growing plant, or on the stem alone.

AUTHOR'S SUMMARY.

The Effect of Nitrogen Containing Fertilizers on the Growth Composition and Seed Value of the Potatoes When Four Different Soils Were Used. (Title translated.) K Kruger, (Halle).

Landwirtschaftlichen Jahrbucher 66 (1927), pp. 781-841.

The author comprehensively reviews the German literature dealing with the deterioration of seed potatoes. The senility theory is not considered tenable. The literature is further discussed as it suggests ecological (or physiological) effects which are "chronic" or reversible and pathological conditions which are considered "acute" or irreversible. Many authors are cited as making statements concerning the effects on seed potatoes of climate, soil, high fertility, heavy nitrogen applications.

Original investigations reported consisted of planting stocks of four varieties of potatoes at four places, each one of which had a different soil-type, and then adding five different nitrogen fertilizers each at two different rates. Data are reported as to yield, starchy content, and total and amino acid nitrogen content. Nitrogen determinations were made in October, in December, and again in May. Seed value was determined by securing data on length and weight of a crop of sprouts produced when tubers were sprouted during the winter.

The plant vigor was greatly improved on the four soil types by increasing the amount of several forms of nitrogen.

On the moor soils plant vigor was very good but tuber yield and starch were low. The loess loam soil produced the highest yield and most starch but the seed was the least productive of any. Lime soils produced very low yields and the seed was very weak.

Increasing the amount of nitrogen on soils low in nitrogen—moor and sandy soils, resulted in vigorous growth and high yields as well as improved seed value. On the heavier soils such practice was associated with higher yields but lower seed vigor. Ammonium sulphate gave best results both in so far as yield and seed value were concerned. Calcium and sodium nitrate were not very effective in increasing yields and the seed from those plants was inferior. The soil type and nitrogen fertilizer exerted a similar influence both on total nitrogen and amino acid nitrogen of the tubers. The moor and sandy soils the content of total nitrogen and amino acid content was low in contrast with that from the loes and lime soils.

The amino acid nitrogen content of the tubers changed during the storage period. From October to December there was a decrease in amino acid nitrogen in the tubers from the moor and sandy soils, whereas on the heavy soils there was an increase. This increase could be increased even more by increasing the amount of nitrogen fertilizer, especially in the form of ammonium sulphate. The tubers from heavy soils showed a decline in amino acid nitrogen content during this same period.

The author considered the smaller proportion of amino acid nitrogen to total nitrogen during winter storage than at planting time as an indication of high seed value. High amino acid content during storage with a low content at planting time was associated with weakening seed tubers.

The tubers from moor and sandy soils showed a great difference in the relation of amino acid to total nitrogen during storage and a small difference at planting time. In the heavy soil tubers on the contrary there was a small difference during storage but a great difference in the spring.

Each variety was found to have its own pH at normal vigor, varying from pH 5.8 to 6.5. Source and fertilization altered this somewhat. With ammonium sulphate addition the tuber pH was lowered and plant vigor increased. The nitrate fertilizers gave higher pH values in tubers and decreased vigor. These pH differences were, however, within rather small limits.

Data are also presented concerning the relation of the composition of the tubers produced at different places, more or less continuously, upon their seed value.

—H. O. WERNER.